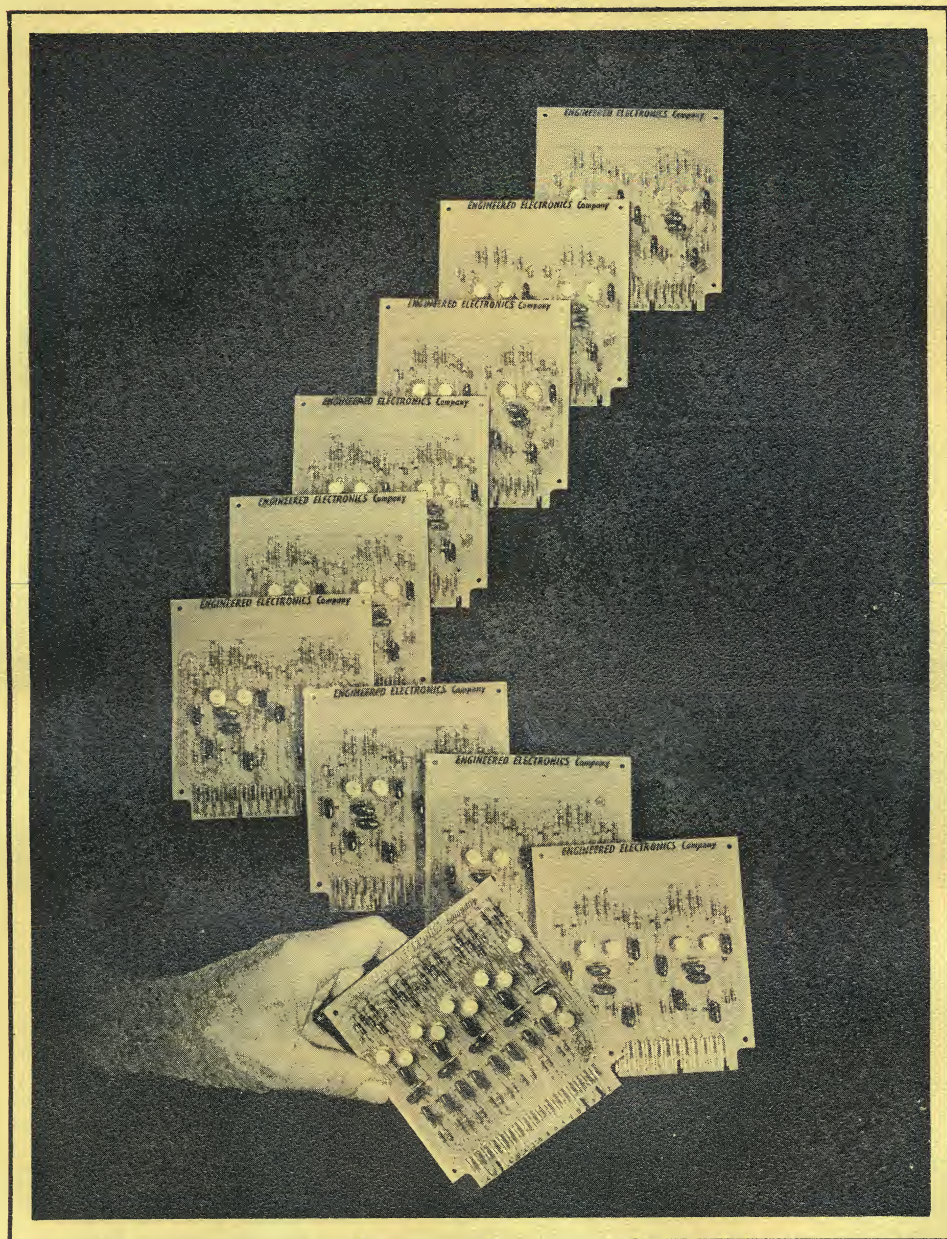


GA

SERIES DIGITAL CIRCUIT MODULES

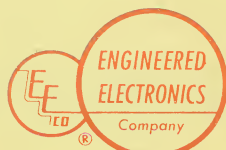
JULY 1965



*A
Coordinated
Family of
10 MC, 1 MC, and
100 KC Modules.*

***HIGH QUALITY
HIGH SPEED
LOW COST***

- True economy in military quality modules.
- Backed by EEC's lifetime warranty.
- Speeds of 100 kc, 1 mc and 10 mc.
- Off-the-shelf delivery.
- Standard loading rules.
- Utilizes widely accepted VARICON connectors.
- Reliable—"worst case" design.
- All GA modules are compatible with all other GA units.
- Full temperature range from -55° to $+71^{\circ}\text{C}$, operating.
- Features EEC's patented protection against short circuits.



GA SERIES

This short form catalog describes EEC's reliable GA Series of etched circuit board modules. Select from 76 off-the-shelf units for either synchronous or non-synchronous use—in the speed range of your choice.

For NON-SYNCHRONOUS APPLICATIONS, GA modules are used in conventional carry-trigger fashion without need for intervening amplifiers or special clocking techniques. IN SYNCHRONOUS USE, they primarily implement logical expressions of the "And-to-Or" variety. Flexibility of logic loading considerations permits rapid and uncomplicated system design.

Modules are stocked for off-the-shelf delivery. If you don't find exactly the module you need here, contact EEC or your EEC rep because the GA line is constantly being expanded. Then, if a standard module is not available, EEC is equipped to produce "specials" for you.

Whichever GA modules you specify, you are assured of quality.

Common to all GA modules:

- Logic levels of
0 volts = binary "0"
-6 volts = binary "1"
- Required voltages of -12, -6 and +6 v.
- $4\frac{1}{2}$ " x 5" x $\frac{1}{16}$ " glass epoxy cards for mounting in standard card buckets or drawers.

10 MC

All 10 mc modules have fan-in and fan-out of 5 at 10 mc and 10 at 5 mc.

PART NO.	NAME	QUANTITY ON CARD	DESCRIPTION	PRICES
GA-101A	Flip-Flop JK	2	Two JK flip-flops for synchronous or asynchronous digital systems. Set, reset, and clock input.	1 - \$51.85 10 - \$47.50 100 - \$43.20
GA-102	Logic Amplifier	3	Three logic amplifiers to terminate diode logic arrays without inversion.	1 - \$63.30 10 - \$58.05 100 - \$52.75
GA-103	Logic Inverter	2	Two logic inverting amplifiers to terminate diode logic arrays with inversion.	1 - \$58.75 10 - \$53.85 100 - \$48.95
GA-104A	Inverter	4	Four inverting amplifiers to provide logic gain with inversion. A "NAND" gate can be formed by connecting diode "AND" extenders to the direct input.	1 - \$44.65 10 - \$40.90 100 - \$37.20
GA-105A	Clock Driver	1	Clock driver to supply clock pulses for up to 30 units.	1 - \$65.15 10 - \$59.75 100 - \$54.30
GA-106	Linear Amplifier	1	Non-inverting, linear amplifier for amplifying low-level signals. Provides gains of x10, x31.6 and x100 within frequency range of 20 cps to 10 mc.	1 - \$33.65 10 - \$30.95 100 - \$27.05
GA-107	Squaring Amplifier	1	Inverting, squaring amplifier for shaping medium amplitude waveforms. An ac input is provided for sinusoidal waveforms from 150 kc to 10 mc. A dc input is provided for squaring signals, as from lower frequency GA units.	1 - \$45.65 10 - \$41.90 100 - \$37.45
GA-108	"NAND" Gate	3	Three 2-input, diode "NAND" gates. Extender input allows gate inputs to be expanded. Non-connected output load resistors included so outputs can be paralleled.	1 - \$37.15 10 - \$35.05 100 - \$30.95
GA-111A	Flip-Flop JK	2	Two JK flip-flops with common clock input. Set and reset logic gate, expandable to multi-input "AND" gates. Reset logic gate also expandable to multi-input "AND-OR" gate.	1 - \$57.90 10 - \$53.10 100 - \$48.25
GA-121	Flip-Flop JK Extender, Diode "AND" Gate Resistors	2 4 4	Two JK flip-flops similar to GA-101A. Four 3-input diode "AND" extenders and four gate resistors.	1 - \$60.10 10 - \$55.10 100 - \$50.10
GA-122	Logic Amplifier, Logic Extender, Diode "AND"	3 3 3	Three logic amplifiers. Three 4-input diode "AND" gates and three 2-input diode "AND" extenders.	1 - \$72.10 10 - \$66.10 100 - \$60.10
GA-123	"NAND" Gate, Diode "AND" Extender	4 2	Four 2-input, diode "NAND" gates. Also, two 3-input diode "AND" extenders.	1 - \$48.65 10 - \$44.60 100 - \$40.55

WARRANTY

Engineered Electronics Company hereby warrants standard circuit modules of our manufacture* to be free from defects. It at any time a module fails in normal service due to defective parts, workmanship or packaging, Engineered Electronics Company will repair or replace the module without charge, providing required parts are still available. In addition, repairable modules damaged by misuse, accident, neglect, or improper installation, will be repaired at cost.

*Except indicators and power supplies.

1 MC

All 1 mc modules have fan-in and fan-out of 10 at 1 mc and 15 at 500 kc.

PART NO.	NAME	QUANTITY ON CARD	DESCRIPTION	PRICES
GA-201	Flip-Flop JK	2	Two JK flip-flops for synchronous or asynchronous digital systems. Each has a set, reset and clock input.	1 - \$29.90 10 - \$27.40 100 - \$24.90
GA-202	Logic Amplifier	3	Three logic amplifiers to terminate diode logic arrays without inversion.	1 - \$38.30 10 - \$35.10 100 - \$31.90
GA-203	Logic Inverter	2	Two logic, inverting amplifiers to terminate diode logic arrays with inversion.	1 - \$34.15 10 - \$31.30 100 - \$28.45
GA-204A	Inverter	4	Four inverting amplifiers to provide logic gain with inversion. A "NAND" gate can be formed by connecting diode "AND" extenders to the direct input.	1 - \$26.50 10 - \$24.30 100 - \$22.10
GA-205	Clock Driver	2	Two clock drivers to supply the clock for up to 50 units.	1 - \$63.70 10 - \$58.85 100 - \$48.20
GA-206	Linear Amplifier	1	One inverting linear amplifier for amplifying low-level signals. Provides gains of x10, x45 and x90 from 50 cps to 1 mc.	1 - \$22.90 10 - \$21.00 100 - \$19.10
GA-207	Squaring Amplifier	1	An inverting, squaring amplifier for shaping medium amplitude waveforms. An ac input is provided for sinusoidal waveforms from 1 kc to 1 mc, and a dc input for squaring signals from lower frequency GA units and level shifting.	1 - \$22.80 10 - \$20.90 100 - \$19.00
GA-208	"NAND" Gate	3	Three 2-input, diode "NAND" gates. Extender input provided to expand number of gate inputs. Non-connected output load resistors included so outputs can be paralleled.	1 - \$23.00 10 - \$21.05 100 - \$19.15
GA-211	Flip-Flop JK	2	Two JK flip-flops with a common clock input. Set and reset logic gate expandable to multi-input "AND" gates. Reset logic gate can also be expanded to a multi-input "AND-OR" gate.	1 - \$36.00 10 - \$33.00 100 - \$30.00
GA-221	Flip-Flop JK, Diode "AND" Extender Gate Resistors	2 4 4	Two JK flip-flops, four 3-input diode "AND" extenders, and four gate resistors.	1 - \$35.90 10 - \$32.90 100 - \$29.90
GA-222	Logic Amplifier, "AND" Gates, Diode "AND" Extenders	2 4 4	Three logic amplifiers, three 4-input diode "AND" gates, and three 2-input diode "AND" extenders.	1 - \$47.40 10 - \$43.45 100 - \$39.50
GA-223	"NAND" Gate, Diode "AND" Extenders	4 2	Four 2-input diode "NAND" gates and two 3-input diode "AND" extenders.	1 - \$28.10 10 - \$25.75 100 - \$23.40
GA-224	Astable Multivibrator	1	A free-running multivibrator used as a timing source. Sync input for synchronization with an external signal, control inputs that enable or disable the free-running operation, and a buffered output so frequency is not affected by loading.	1 - \$26.60 10 - \$24.35 100 - \$22.15
GA-225	Flip-Flop JK	4	Four JK flip-flops, similar to GA-201.	1 - \$46.55 10 - \$42.70 100 - \$38.80

SPECIAL CARDS & HARDWARE

PART NO.	NAME	DESCRIPTION	PRICES
H-194-2	Blank Card (VARICON)		\$ 7.00
H-228	Card Extender (VARICON)		\$25.00
H-410A	Card Extractor		\$13.00
H-462-XXX	0 to 340-bit Thin Film Shift Register	Stores up to 340 bits. Can be clocked at rates up to 1 mc. Information stored is non-volatile. Unit to be used with GA-524. Three "Xs" indicate bit storage capability to fit applications from 0 to 340 bits.	1 - \$1,700 10 - \$1,360 100 - \$1,020

100 KC

PART NO.	NAME	QUANTITY ON CARD	DESCRIPTION	PRICES
GA-301	Gated Flip-Flop	2	Two pedestal gated flip-flops. Set logic and set pulse input, reset logic and reset pulse input, and dc reset.	1 - \$20.00 10 - \$18.30 100 - \$16.65
GA-302	Logic Amplifier	1	Three logic amplifiers providing logic gain without inversion.	1 - \$17.20 10 - \$15.80 100 - \$14.35
GA-303	25 KC NOR Gate	3	Three 4-input resistor NOR gates.	1 - \$13.70 10 - \$12.55 100 - \$11.40
GA-304	'PNP' Power Driver	6	Six 'PNP' emitter-follower power drivers for increasing fan-out to 20 NOR gate type loads. A diode from input to output of each driver allows the preceding circuit to supply rise time and false level to the load.	1 - \$16.10 10 - \$14.75 100 - \$13.40
GA-305A	Clock Driver	1	Drives up to 75 pulse inputs. Output is clamped at -6 volts.	1 - \$24.15 10 - \$22.15 100 - \$19.70
GA-306	One Shot	1	One shot to generate pulse widths from 4 μ sec to 15 sec with external timing capacitors.	1 - \$13.50 10 - \$12.40 100 - \$11.25
GA-307	Squaring Amplifier	1	Non-inverting, squaring amplifier for squaring medium amplitude waveforms. An ac input provided for sinusoidal waveforms from 50 cps to 100 kc. A dc input is used for waveform restoration and level shifting.	1 - \$16.00 10 - \$14.70 100 - \$13.35
GA-308	NOR Gate	3	Three 4-input, diode NOR gates.	1 - \$16.25 10 - \$14.90 100 - \$13.55
GA-311	Gated Flip-Flop	2	Two pedestal gated flip-flops with a common dc reset input. Each has a set and reset logic input with a common pulse input, and an internally steered set-reset pulse input.	1 - \$25.10 10 - \$23.00 100 - \$20.90
GA-321	Four Flip-Flops, "NAND" Gate	5	Four pedestal gated flip-flops with common dc reset. One 2-input DCTL "NAND" gate. A complete decade can be implemented on one card. Can be used as 4-bit shift register.	1 - \$36.00 10 - \$33.00 100 - \$30.00
GA-322	NOR Gate	6	Six 4-input, diode NOR gates.	1 - \$25.10 10 - \$23.00 100 - \$20.90
GA-323	Astable Multivibrator	1	Free-running multivibrator used as timing source. Sync input for synchronization with external signal, control input to enable or disable free-running operation, and buffered output so frequency is unaffected by loading.	1 - \$19.40 10 - \$17.75 100 - \$16.15
GA-324	'NPN' Power Driver	10	Ten 'NPN' emitter-follower power drivers for increasing fan-out to 25 "NAND" gate type loads. A diode from input to output of each driver allows the preceding circuit to supply the fall time and true level to the load.	1 - \$22.10 10 - \$20.25 100 - \$18.40
GA-325	"NAND" Gate	6	Six 4-input, diode "NAND" gates.	1 - \$25.15 10 - \$23.05 100 - \$20.95
GA-326	DCTL "OR" Gate	7	Seven DCTL "OR" gates connected as three 3-input and four 2-input "OR" gates. With exception of one 2-input unit, the gates have non-connected output load resistors so outputs can be connected in parallel.	1 - \$24.20 10 - \$22.15 100 - \$20.15
GA-327	DCTL "AND" Gate	7	Seven DCTL "AND" gates connected as three 3-input and four 2-input "AND" gates. With exception of one 2-input unit, the gates have non-connected output load resistors so outputs can be connected in parallel.	1 - \$29.75 10 - \$27.30 100 - \$24.80
GA-328	Pulse Gate	4	Four pedestal, pulse gates with integral amplifiers. Each has a pulse input, four control inputs and a direct input for expanding control inputs. Two have non-connected output load resistors to facilitate paralleling output. Gate is enabled when all control inputs are at 0 v and disabled when any one input is at -6 v.	1 - \$34.50 10 - \$31.65 100 - \$28.75
GA-329	Flip-Flop Shift Register	4	Four pedestal gated flip-flops with common dc reset input. Each has a set and reset logic input with common pulse input. A second set logic and set pulse input is provided. Unit can be used as a serial shift register with parallel input.	1 - \$37.15 10 - \$34.05 100 - \$30.95
GA-330	One Shot	4	Four one shots, external pulse width is controlled by means of a capacitor.	1 - \$29.15 10 - \$26.75 100 - \$24.30
GA-331	Logic Inverter	15	Fifteen inverters providing logic gain with inversion.	1 - \$31.40 10 - \$28.75 100 - \$26.15

Related Modules

GA-400 Series

Diode logic units allow GA-100 Series active circuits to work up to 10 mc clock rates with a fan-out of 5.

NOTE—Letters in parenthesis indicate connections to gate centers and may be used to expand the equation with external diodes.

PART NO.	NAME	QUANTITY ON CARD	DESCRIPTION	PRICES
GA-401	Diode Logic Gate	4	Four logic gates interconnected to give two identical logic arrays. Typical equation that can be mechanized: (A) = CDE, (B) = EFG	1 - \$16.10 10 - \$14.75 100 - \$13.40
GA-402	Diode Logic Gate	8	Eight logic gates interconnected to give two identical logic arrays. Typical equation that can be mechanized: (A) = EG (C) = FG (B) = EH (D) = FH	1 - \$20.10 10 - \$18.45 100 - \$16.75
GA-403	Diode "AND" Extender	5	Five diode "AND" extenders for expanding "AND" gates and "NAND" gates. Diodes are connected as two 2-input and three 3-input "AND" clusters.	1 - \$13.20 10 - \$12.10 100 - \$11.00
GA-404	Diode Logic Gate	8	Eight logic gates interconnected to give one logic array. Typical equation that can be mechanized: (A) = JL (E) = KN (B) = JM (F) = KP (C) = JN (G) = KR (D) = JP (H) = KS	1 - \$20.30 10 - \$18.60 100 - \$16.90
GA-405	Diode Logic Gate	10	Ten logic gates interconnected to give one logic array. Typical equation that can be mechanized: A = C+EG+HK+LN+PR(S) B = D+FG+JK+MN+PR(S)	1 - \$25.25 10 - \$23.15 100 - \$21.05
GA-406	Diode Logic Gate	10	Ten logic gates interconnected to give one logic array. Typical equation that can be mechanized: (A) = C (K) = PS (B) = C (L) = HL (D) = FG+J (M) = GS (E) = FH+J (N) = GRS	1 - \$23.30 10 - \$21.35 100 - \$19.40
GA-421	Diode Logic Gate	8	Eight logic gates interconnected to give two identical logic arrays. Typical equation that can be mechanized: (A) = CDE (H) = JKLM (B) = EFG (N) = PR	1 - \$23.40 10 - \$21.45 100 - \$19.50

GA-500 Series

Accessories for use with various GA modules.

PART NO.	NAME	QUANTITY ON CARD	DESCRIPTION	PRICES
GA-501	Nixie Driver and Decoder	1	Decoding matrix and Nixie driver for converting a 1-2-4-8 or 1-2-4-5 BCD code to a 10-line decimal output capable of driving an external Burroughs miniature Nixie tube. Driver is "on" when proper inputs are at 0 v and "off" at -6 v.	1 - \$102.00 10 - \$ 93.65 100 - \$ 85.15
GA-502	1 KC Relay Driver	4	Four relay drivers for controlling external relays requiring up to 100 ma at -35 v or less. Driver is "on" when input is at -6 v and "off" at 0 v.	1 - \$26.00 10 - \$23.80 100 - \$21.65
GA-504	1 KC Relay Driver	1	Driver for controlling an external relay requiring up to 1 amp at -30 v or less; is "on" when input is at -6 v and "off" at 0 v.	1 - \$26.55 10 - \$24.45 100 - \$21.00
GA-506	5 MC One Shot	1	Used to generate pulse widths from 0.1 μ sec to 40 μ sec with internal capacitors. TRIMPOT [®] included for fine control of pulse widths.	1 - \$49.15 10 - \$45.10 100 - \$40.50
GA-507	Neon Driver	8	Eight drivers for controlling external neon lamps. "On" when input is at -6 v and "off" at 0 v.	1 - \$30.70 10 - \$28.15 100 - \$25.60
GA-508	Neon Driver	10	Ten drivers and associated neon lamps mounted on card. Lamp is "on" when input is at -6 v and "off" at 0 v.	1 - \$40.90 10 - \$37.50 100 - \$34.10
GA-510A	10 MC Crystal Oscillator	1	Crystal-controlled, buffered oscillator used as a primary timing source. Crystal in a temperature-controlled oven. Output waveform is a square wave.	1 - \$104.00 10 - \$ 96.70 100 - \$ 77.90
GA-517	100 KC Voltage Comparator	4	Four independent voltage comparators. +12 v required instead of +6 v.	1 - \$37.25 10 - \$34.15 100 - \$31.05
GA-518	Digital-to-Analog Converter	1	Converts 4-input bits binary or BCD to very precise analog voltage.	1 - \$83.40 10 - \$73.10 100 - \$63.60
GA-523	Readout Driver	1	Converts 4 bit BCD to decimal for driving the projected image, incandescent readout.	1 - \$55.80 10 - \$51.15 100 - \$46.50
GA-524	Input/Output Driver	1	Used to drive and terminate an H-462 thin film memory register.	1 - \$42.50 10 - \$38.95 100 - \$35.40

GA-600 Series

Diode logic gates to allow GA-100 Series active circuits to work up to 5 mc clock rates with a fan-out of 10, and to allow GA-200 Series active elements to work up to 1 mc clock rates with a fan-out of 10.

PART NO.	NAME	DESCRIPTION	PRICES
GA-601	Diode Logic Gate	Logically identical to GA-401.	1 - \$16.10 10 - \$14.75 100 - \$13.40
GA-602	Diode Logic Gate	Logically identical to GA-402.	1 - \$19.90 10 - \$18.25 100 - \$16.60
GA-603	Full-Adder Diode Logic Gates	Two full-adder logic arrays to perform binary addition.	1 - \$34.10 10 - \$31.25 100 - \$28.40
GA-604	Diode Logic Gate	Logically identical to GA-404.	1 - \$20.40 10 - \$18.70 100 - \$17.00
GA-605	Diode Logic Gate	Logically identical to GA-405.	1 - \$25.25 10 - \$23.15 100 - \$21.05
GA-606	Diode Logic Gate	Logically identical to GA-406.	1 - \$23.50 10 - \$21.55 100 - \$19.60
GA-621	Diode Logic Gate	Logically identical to GA-421.	1 - \$23.75 10 - \$21.80 100 - \$19.80

GA-700 Series

Diode logic gates to allow GA-200 Series active circuits to work up to 500 kc clock rates with a fan-out of 15.

PART NO.	NAME	DESCRIPTION	PRICES
GA-701	Diode Logic Gate	Logically identical to GA-401.	1 - \$16.20 10 - \$14.85 100 - \$13.50
GA-702	Diode Logic Gate	Logically identical to GA-402.	1 - \$20.15 10 - \$18.50 100 - \$16.80
GA-703	Diode "OR" Extender	Five independent diode "OR" extenders for expanding "OR" gates. Diodes are connected as two 2-input and three 3-input "OR" clusters.	1 - \$13.45 10 - \$12.30 100 - \$11.20
GA-704	Diode Logic Gate	Logically identical to GA-404.	1 - \$20.40 10 - \$18.70 100 - \$17.00
GA-705	Diode Logic Gate	Logically identical to GA-405.	1 - \$25.40 10 - \$23.25 100 - \$21.15
GA-706	Diode Logic Gate	Logically identical to GA-406.	1 - \$23.70 10 - \$21.75 100 - \$19.75
GA-721	Diode Logic Gate	Logically identical to GA-421.	1 - \$23.50 10 - \$21.55 100 - \$19.60

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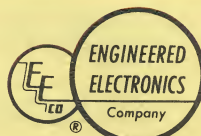
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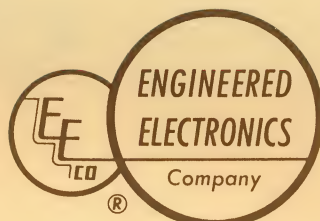
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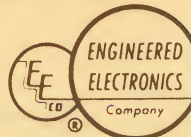
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